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ABSTRACT

Despite the widespread introduction of microcomputers into the nation's schools, tremendous variations exist in the frequency and success of their implementation. This study focuses on the principal's role as one possible cause of these variations. Recent research has identified two major role activities of principals: instructional leadership and school management. Instructional leadership activities, generally considered an important factor in creating effective schools, include goal setting, supervising instruction, and active decision making. School management activities, considered more "typical" and less dynamic in nature, include tasks such as record keeping, scheduling, and building operations. To examine the nature of these two roles and to determine their impact on the implementation of microcomputer use, data was collected from teachers, principals, and media center directors in a random sample of 130 elementary schools in northeastern Illinois. The findings show that although some elements of instructional leadership are associated with successful implementation, schools whose principals are skilled managers have the strongest computer curricula. Their effectiveness in coordinating and facilitating new programs suggests a new area of inquiry for the theory of instructional leadership. Five pages of references, two tables, and two figures are appended. (IW)

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The Instructional Leader as Middle Manager:

The Principal's Role in Implementing a Technological Innovation

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Abstract

Studies of "effective" schools frequently credit the instructional leadership of the principals. Principals who are not dynamic leaders, the managers, are regarded as "typical" and generally ineffective. The primary purposes of this study are to examine the nature of these two roles and to determine their impact on the implementation of microcomputers. To fulfill these objectives, the author collected data from teachers, principals, and media center directors in a random sample of 130 elementary schools. The findings show that although some elements of instructional leadership are associated with successful implementation, it is in schools where the principals are skilled managers that one is most likely to find strong computer curriculums. Moreover, the regression analysis indicates that one aspect of management, coordination, directly affects the level of computer implementation.

Problem Statement

In the last two decades technology has become commonplace in elementary schools. Few schools exist which do not contain at least a few pieces of equipment such as a television, film projector, reading machine, video cassette recorder, or a microcomputer. In many, if not most, schools, however, technological innovations are not an integral part of the curriculum (Lipson, 1981). After their adoption and perhaps an initial flurry of use, they have yet to be implemented into the regular curriculum (Pincus, 1974). Notes Sarane Boocock (1980): "During the 1960s a number of technological innovations were introduced in American classrooms . . . it is interesting to note that by the early 1970s most of these innovations had disappeared or changed almost beyond recognition" (p. 174).

The 1980s have brought more innovations but with no more successful implementation than found in the two previous decades. The microcomputer is the most recent and widespread example. School boards, administrators, teachers and parent groups have rushed to obtain inexpensive microcomputers for their schools (Wineripe, 1983). Once the machines are placed in the schools, however, a tremendous variation in the frequency and type of use becomes evident (Becker, 1982). To be sure, several causes for the

variations of the level which technology is implemented exist (Jackson, 1967; Oettinger, 1969; Gross, Giacquinta, and Bernstein, 1971; Caldwell, 1981), but in this paper the author will focus on one particular cause, the principal's role in implementing technological innovations.

The scarce literature on this topic suggests that his or her endorsement, sustained support, and ability to overcome resistance to the innovation are crucial to successful implementation (Gross, et al., 1971; Crowther, 1972; Berman et al., 1978; Miles, 1978; Runkel, R. A. Arends, J. Arends, and Francisco, 1979; Reinhard, Arends, Burns, Kutz, and Wyant, 1980; Rutherford, 1981), the terms are merely vague descriptors. Rather than looking at support or encouragement alone, the author has chosen to examine a broad range of managerial and leadership activities. Managerial activities include tasks such as record-keeping, scheduling, and operating a smooth running building. Principals who are managers are regarded as "typical" (Leithwood and Montgomery, 1982), and their contributions to the school are largely ignored in the literature. Leadership activities are more dynamic in nature; they include goal setting, supervising instruction, and active decision-making concerning curricular matters (Leithwood and Montgomery, 1982). Studies of effective

schools frequently note that effective schools have principals who are strong instructional leaders (Kroeze, 1984).

The primary objective of this paper is to investigate the extent to which managerial and leadership attributes of the principal influence the implementation of the newest technological innovation, the microcomputer. A second objective is to determine the relative importance of principals' managerial and leadership behavior in schools which have successful computer curriculums.

Theoretical Framework and Selection of Variables

The two managerial variables selected for study were "problem-finding" and "coordination." The first originates in Dewey's theory of inquiry (1938) and Peirce's theory of abduction (Hartshorne, Weiss, and Burkes, 1931-35) and finds further refinement in the work of Getzels (1979), Schon (1979), and Kolb (1981).

Problem-finding is the act of recognizing, identifying, discovering, or setting the particular problems a dilemma (an unfamiliar, uncomfortable, or irritating situation) may entail. As the chief administrator of the school, a principal faces countless problems each day. Several are easily resolved, requiring an automatic or simple answer or

reference to a specific policy, but others are more difficult, requiring thought, consultation, or extended investigation into the question before a decision is made. The arrival of technology in the elementary school presents the principal with a dilemma, the resolution of which will influence the access students and teachers have to the equipment, their opportunities to learn to use the machine, and possibly their attitude toward the innovation. When confronted with a dilemma, it is essential for the administrator to identify the problem precisely, for as John Dewey (1938) wrote:

> A problem well put is half solved . . . To find out what the problems are which an indeterminate situation presents . . . is to be will along in inquiry. To mistake the problem involved is to cause subsequent inquiry to be irrelevant or to go astray. Without a problem there is blind groping in the dark (p. 106)

More recently, the theoretical work of James March and Herbert Simon (1976), Chris Argyris (1964), and Daniel Griffiths (1958) emphasize that searching for, discovering, defining, and understanding the problem are crucial to effective decision-making. Gross et al. (1971) also concluded that problem recognition was essential for implementation:

> Our findings . . . indicated that the teachers' growing disenchantment with the innovation . . . was a result of many conditions that the administration did not recognize, ignored, or dealt with in inept ways.
>
> These findings led us to conclude that the teachers were unable to implement the innovation largely because the administration failed to recognize or to cope effectively with the problems, difficulties and uncertainties to which it exposed teachers when it asked them to carry it out (p. 200-201).

Despite its potential impact on the school, problem-finding is a managerial variable because its activity primarily consists of reflective thought and is most productively pursued in the office or during quiet uninterrupted moments of the day which are rare in a principal's life.

The second managerial variable, coordination, involves the specific activities designed to make the building run smoothly. These include scheduling computer use, arranging for inservice training, acquiring helpful resources, and creating a favorable climate for innovation. This variable is suggested by the work of Downs (1967) and Thompson (1980). They argue that organizational structure is resistive to change. Consequently, implementation can only proceed with skillful coordination of resources to modify the existing organizational structure or to incorporate the innovation without disturbing the established structure and function of the school.

The first two leadership variables, "use of economic incentives" and "use of political incentives" are derived from the work of Niskanen (1973) and Tullock (1969). Both claim that individuals in a bureaucracy make decisions based on personal goals, not organizational ones. Niskanen maintains that these decisions are frequently "budget maximizing" activities. That is, individuals make decisions which benefit them financially. Thus, for implementation to succeed, individuals would have to be given financial incentives. Tullock argues, however, that political incentives, those rewards which increase the strength of one's position or offer potential for promotion, are the most powerful incentives. Economic incentives include direct payments to teachers, release time, inservice credits, tuition reimbursement for training, or a financial bonus for serving on an implementation steering committee. Political incentives include formal recognition by the central office or school board, media coverage, or public recognition.

The third, "time and attention" given to the innovation, has roots in the work of Cohen, March, and Olsen (1972) and is supported by the empirical findings of Carpenter-Huffman, Hall and Sumner (1974) and Gross et al. (1971) who note that a principal's sustained attention to the innovation is necessary for successful implementation.

The fourth leadership variable, "goal-setting," originates in the theoretical work of March and Olsen (1976) and Cyert and March (1963). The use of this variable as an indicator of leadership is supported by Leithwood and Montgomery's (1982) extensive review of studies of innovation. They write, "Effective principals were exceptionally clear and unambiguous about the school's goals" (p. 330).

The final variable, "expertise" of the principal, is an extension of Simon's (1976) argument that rational decisions need to be based on as much information as possible. The more knowledge one has about the microcomputer and its applications, the more able will he or she be to make appropriate decisions. Leithwood and Montgomery (1982) note that one of the greatest obstacles to program improvement stems from the principal's own lack of knowledge, skill, and motivation (pp. 332-333).

In a similar manner, the author has drawn the dependent variables which consist of several different measures of implementation, from both theoretical and empirical sources. Gross et al (1971) and Fullan and Pomfret (1977) have argued that a major problem with studies of innovation is the lack of precise measures of implementation, and Fullan and Pomfret have listed criteria which such measures should meet. Becker's (1983) recent nationwide study of computer use has shown that some measures of implementation can be accurately assessed. By using Fullan and Pomfret's guidelines, by working with administrators, teachers, and students as they use computers, and by reading Becker's work, the author was able to devise a means for measuring ten different aspects of implementation: the accessibility of the machines, the frequency of daily use, the trend in computer use, the percentage of students using the computer regularly, the range of academic ability of student users, the variety of modes for which the computer is used, the extent of programming instruction, the extent of CAI use, the teachers' level of computer literacy, and the staff's perception of the impact of the computer on the curriculum. These variables provide a thorough picture of the schoolwide impact of the computer. The primary dependent variable used in this study is "total implementation," a composite measure

of the ten. Throughout the following discussion, the author will examine how the particular actions of the principal affect this variable.

Methodology

For this study, the author used a large simple random sample of 160 elementary schools in the seven northeasternmost counties in Illinois. From phone calls to superintendents and principals, he found that twenty-six of these schools did not have computers and six principals did not wish to have their schools included in the study. The final sample, then, consisted of 128 elementary schools. Of these, twenty-one were kindergarten through eighth grade schools (K-8), sixty-five were K-6, fourteen were K-5, six were K-4, five were K-3, four were 4-8, four were 5-8, three were 6-8, two were 4-5, and there was one each of grades K-2, 3-4, 3-5, and 4-6.

To measure the extent to which the ten dependent and eight independent variables were present in each school, the author developed self-administered questionnaires for the principal, learning center (media center) director, and classroom teachers. These instruments were first used in a pilot study and then revised to meet stringent criteria for validity and reliability (McGee, 1985). Although the three questionnaires differed in content and length, each provided information about all variables.

Because all variables were assessed by responses to more than one question, the scoring method involved several steps. First, on every questionnaire the researcher converted the raw scores for each question to a scaled score. Second, he averaged all of the scaled scores for a particular variable on each questionnaire. Third, after all questionnaires for a school were scored and uniformly scaled, the author averaged all of the teachers' questionnaires to obtain a composite teachers' score for each variable. Finally, the composite (mean) teachers' score for each variable was averaged with the learning center director's scaled score and the principal's scaled score to give one final scaled score for each dependent and independent variable. By using the average of the three categories of respondents' scaled scores, the author hoped to reduce the influence of systematic bias any one group might have toward over- or under-reporting any measures.

To guarantee a large response rate, the author used several means. First, before proceeding with the survey, he wrote the superintendent of each school district a letter which explained the project. Soon after they received the letter, he called them to obtain permission for the research. Second, once the superintendent granted permission, the author met briefly with each principal to

explain the purpose of the study and the questionnaires. Third, having made initial contact, the author left the questionnaires and then returned to collect them three to six weeks later. Fourth, each respondent received an envelope marked CONFIDENTIAL for the completed questionnaire as well as a cover letter which assured the confidentiality of all responses. This provision for anonymity encouraged teachers and administrators to complete the questionnaires thoroughly and honestly. Finally, the questionnaires were easy to complete requiring the respondent to spend between ten minutes (teachers) and thirty minutes (principals) answering the questions.

These methods of data collection produced a high return rate. The author received 99.2% (127 of 128) principal's questionnaires, 100% (105 of 105) of the learning center director's, and 78.8% (1170 of 1484) teacher's surveys. For the final data analysis, however, eighteen of the schools had to be dropped. Four were eliminated because the computers had been in the building only a few weeks and had not yet been used by students. Ten others had to be dropped because the author did not obtain a sufficient sample of teachers. Only a few of the teachers in each of these ten schools completed questionnaires, and they were all avid users and highly computer literate. Most

could write programs in BASIC for their students to use. Their responses were not representative of the staff and would have biased the implementation variables upward. Four other schools were dropped because no teachers completed the questionnaires. In these schools the computer program was taught as a separate course by a special teacher much like physical education or music are taught in most elementary schools.

The final sample used for the data analysis contained responses from 110 schools. These included 100% of the principals and learning center directors and 84.5% of the teachers.

Correlations of Decision-making Variables with Total Implementation

The purpose of this study is to determine which principals' decision-making behaviors are associated with the implementation of microcomputers. To accomplish this goal, the author correlated the total measure of implementation with each of the independent variables for the entire sample as well as for SES and grade span subsamples. He found that five of the decision-making variables were significantly correlated with the total implementation score. These are listed in Table 1.

Insert Table 1 about here

As predicted, the the correlations between total implementation and COORD, GOALS, POL.INC. and P.LIT. were all positive and significant. The negative correlation for TIME/ATTN., however, was at first surprising for it appeared that the more directly involved the principal was in decision-making, the less the program was implemented. A more sensible explanation, though, is that in schools with low implementation, the principal is more involved just trying to get the program moving. Once a program is fully implemented, he or she may not have to make decisions, but can delegate them to someone more involved in the day-to-day implementation. More highly implemented programs, then, should have less direct principal involvement.

Another surprising finding concerned the weak and insignificant coefficient of problem-finding. Problem-finding apparently precedes the managerial and leadership actions which in turn are associated with implementation. The findings indicate that principals with high scores as

problem-finders rank highly in coordination, goal setting, providing political incentives and computer literacy. and that principals with high scores in these four variables tend to have highly implemented programs; yet, principals with high problem-finding scores are no more likely to have highly implemented programs than are principals with low problem-finding scores. Problem-finding may be a necessary precondition for the activities associated with implementation. This contention is explored in a later section using a path analysis of standardized regression coefficients.

Socio-economic Status (SES) Subsamples

The correlations in Table 1 are for the whole sample, but when compared to the correlations by subsamples, they provide a more precise picture. Table 2 shows the correlations for the entire sample compared to subsamples by SES.

Insert Table 2 about here

The high positive correlations for GOALS and POL.INC. of high SES schools are far above the correlation coefficients for low and average SES schools. In high SES schools, the principal's provision of incentives and establishment of goals are significantly associated with implementation. One may argue that high SES schools have more incentives to offer, but the correlation between SES and available financial incentives is actually negligible. A more plausible explanation is that teachers in high SES schools need more incentives to implement computers. Most teachers said the most important reasons for implementing computers were that "It's good for the students" and "Appreciation of the students." Since students in high SES schools are more likely to have their own home computers, the opportunity to get one in the near future, or the chance to use a friend's, the teachers are not providing an experience or education they may not have received at home. Also, if the students have ready access to a computer outside of school, they may not be so appreciative. Consequently, teachers will need to have more inducement to provide implementation.

The establishment of clear goals is associated with implementation much more strongly in high SES schools than in low or average schools. This finding may be explained by

the fact that in high SES schools principals can make computer instruction a priority while in lower SES schools, issues such as learning basic skills, improving standardized test scores, or maintaining good behavior in the building may be more important goals for the principal.

Another important finding is the strong association of COORD with implementation scores across the range of SES. The three high, significant correlations indicate the the principals who spend more time providing scheduling and training, acquiring resources, and creating favorable conditions for implementation have schools with more highly implemented computer programs.

The only other significant correlation is the strong negative association of the principal's involvement in decision-making for schools with average SES. Once again, this indicates that schools with programs which are not yet implemented or are in the early stages of implementation demand more principal involvement and direct decision-making. As the program gets stronger, the principal need not be directly involved.

Although no other correlation coefficients are significant, one additional finding merits a brief mention. The principal's literacy level is highest in low SES schools. The more the principal knows about the computer

and its operation, the more likely it is to be highly implemented. The principal's literacy level may well indicate the importance he or she attaches to the program. This direct modeling may be more important in low SES schools for three reasons. First, it may be a means to encourage the staff to keep up with growth and change in their profession. Teachers in low SES schools have many problems with students, parents, teaching conditions, and the like which prevent them from keeping current with educational innovations. A principal's most effective method of improving the staff's knowledge of current teaching materials is to master them. Second, in less wealthy schools teachers are less likely to be able to attend workshops and conventions. Consequently, principals may have to pass along information they receive or run workshops in their schools. A third explanation is that low and average SES schools may not have the support staff of high SES schools. Principals in these schools may be solely responsible for implementing the program. They cannot delegate it to a learning center director, district coordinator or committee.

To summarize, the findings presented indicate that both management and leadership variables are associated with implementation of microcomputers. Goal setting (GOALS),

indirect leadership (COORD), the provision of political incentives (POL.INC.), and the principal's literacy level (P.LIT.) are significantly positively correlated with total implementation. Problem-finding (PF), the provision of economic incentives (EC.INC.), and ongoing time and attention (TIME/ATTN) committed to decision-making are not. Moreover, the associations vary in degree in SES subsamples.

One variable, COORD, is significantly correlated with implementation across all SES subsamples. Principals who want to have strong computer programs need to make decisions concerning scheduling, arranging for inservice training, finding and purchasing helpful resources, and incorporating the computer into the school in a way which does not interfere with the existing program but encourages teachers to use it with their students. At this point in the data analysis, the author cannot assert that these activities and other behaviors associated with implementation--goal setting, providing political incentives for implementation, and the principal's ability to understand the operation and application of the computer--will promote the use of technological innovations. He can only say that the principals in schools with the strongest programs exhibit these behaviors. They may also, however, contribute to the total implementation of the technological innovation. The

following section presents findings which reveal the causal relationships between these variables and implementation.

Stepwise Regression Analysis

Many of the correlational findings make sense in a causal model. The principal's efforts to establish clear goals, create a workable schedule and other favorable conditions for implementation, to arrange a training program, to obtain helpful resources, and to provide rewards and incentives for implementation may directly contribute to implementation.

To investigate causality, the author performed a stepwise regression using these and other variables from an earlier study (McGee, 1985) which were significantly correlated with total implementation. The dependent variable was total implementation and independent variables were goal setting, coordination, provision of political incentives, the principals' literacy level, and SES. Variables from the earlier study included measures of teachers attitude (ATT), software adequacy (SFTWR), and student to computer ratio (RATIO). To determine the order variables were entered, the author used the SAS MAXR procedure (SAS Institute, 1982, p. 102). Using this procedure, no variable is forced in at a particular position; thus, the final order of the stepwise regression

equation does not reflect the author's choice for ordering independent variables, but is the result of the stepwise procedure which yields the highest possible R^2 increase for each step. The regression equation in figure 1, then, may be the best of all possible regressions given the variables.

Insert Figure 1 about here

At first glance some of the negative coefficients may be surprising. One would expect a negative coefficient for ratio, since a lower student:computer ratio would certainly make the computer more accessible and thus lead to greater implementation. The SES and teacher attitude (ATT) coefficients are negative because of the scoring procedure. High SES schools had the lowest scaled score and low SES schools had the highest score Likewise, the scale for attitude was such that staff's with the most supportive attitude for implementation had the lowest score.

The other negative coefficients do not make sense conceptually, however. Since GOALS, POL. INC., and P. LIT. are significantly and positively correlated with implementation, their regression coefficients should be positive. In fact, when these are regressed with total implementation one at a time, the coefficients are +.33 for GOALS, +.40 for POL. INC., and +.22 for P. LIT., and all are significant at the $p < .001$ level. As more independent variables are added to the equation, the size of the coefficient declines because of multicollinearity among some of the independent variables. Because there is some overlap among the behaviors independent variables are measuring, the significance of the correlations also diminishes. Some of the negative coefficients, then, are due to multicollinearity, not to the fact that these variables have a negative effect on implementation. Their effect in the regression equation is so small, however, as to be negligible. Although these three variables are associated with total implementation, they apparently do not contribute very much to it.

The model in figure 1 accounts for 49.9% of the variance in total implementation. Though the principal may not be able to change the SES of the school, this model shows that a principal can influence implementation of

technological innovations. COORD was the first variable in the equation accounting for 21.4% of the variance in total implementation. Figure 2 shows how each independent variable contributed to the total change in variance.

Insert Figure 2 about here

The single most important activity of the principal is his or her role in actively scheduling computer use, finding resources to help teachers, arranging for inservice training, and preparing the students, staff, and the setting for implementation. The model also shows the importance of having a low student:computer ratio and adequate software. Financial constraints may prevent the principal from acquiring more hardware and software, but imaginative fund-raising, grant money, or PTA assistance may be a step toward obtaining resources to produce a better program. When working with staff members, the principal needs to use as many means as possible to encourage them to use the machine and should try to promote a positive attitude towards

implementation among the staff. Becoming literate in computer use, using incentives to reward or motivate teachers to implement the computer, and establishing clear goals may not directly contribute as much to implementation as the other behaviors described above, but these variables are significantly correlated with implementation.

The principal's role is key to implementing educational technology. Principals need to provide more than endorsement and support for implementation to succeed. Also, acquiring the machines and delegating decision-making are not likely to lead to implementation. Implementation, then, is not merely a matter of "extended support," but of hard work and active decision-making. In the following section the author will discuss the implications of the findings for the theory and practice of the principal's role in implementing technological innovations.

Conclusions

Coordination

The successful implementation of technological innovations is a function of the principal's ability to make decisions which provide training, resources, and compatible scheduling and conditions necessary to implement the innovation into the school's existing structure.

One major finding of this study indicates that in schools where computers have become an integral part of the curriculum, the principals have been skilled managers. The schools with the most successful programs are those where principals design workable schedules, arrange for inservice training, acquire helpful resources, create ideal conditions and provide supportive incentives.

Causality is clear; schools with highly successful computer programs have active principals who create successful programs. They may not be forceful instructional leaders but can achieve implementation by indirect leadership, that is, by being skilled managers. Scheduling computer use can be a complex problem especially in schools with few computers for a large number of students. To enable as many students as possible to have access to the computer, principals need to create a tight schedule which allows extensive use but does not interfere with day-to-day instruction. The hours the principal spends behind his or her desk designing a workable schedule will contribute to implementation. Arranging inservice training for teachers may be a more important task and is probably a strong contributor to implementation. The documented reluctance, anxiety, apathy, and fear teachers exhibit to computers is understandable if they do not receive adequate training.

Trying to learn to operate a computer can be very frustrating and discouraging especially when one is overburdened by curriculum demands and has students who may be more competent in computer operation than the teacher. Though this study did not measure the exact relationship between training and implementation, a reading of the findings indicates that principals who get their teachers trained in computer operation will be likely to have successful programs. Once teachers are carefully trained, they will be able to implement the innovation.

Another management aspect of the principal's job is acquiring resources which facilitate implementation. These include software, magazines, textbooks, helpful ideas or lesson plans, furniture, and the like. Abundant resources may be essential for implementation. Implementing computers is difficult enough for students without having to solve problems of complicated software or uncomfortable, cramped workspaces or having to write units or generate exciting computer related activities for an individual or group of students. Teachers who have to spend an inordinate amount of time solving problems or planning lessons probably will not be as enthusiastic about promoting implementation as teachers who do not have to handle such issues. If a principal can acquire the resources which make

implementation more easy and effective for teachers and students, he or she will have a better program.

Besides acquiring resources, a principal also needs to make conditions for implementation compatible with the nature of the school. For example, principals in schools which have two or three floors might have a difficult time arranging for a machine to be transported from one classroom to another. They would need to have computers in a central location where a teacher could bring a group or class of students. Other compatible conditions a principal could arrange are volunteer parent supervisors, computer hallway bulletin boards, a licensing procedure for student use, a computer fair for students to display their programs and the like. By making implementation easy and enjoyable for teachers and students, a principal can almost insure a successful program.

Problem-finding

The successful implementation of technological innovations does not appear to be a function of the principal's ability to recognize and discover potential problems the innovation presents and to make decisions which solve them before and during the process of implementation.

Problem-finding may be a precondition for decision-making which directly leads to implementation. Earlier

findings (McGee, 1985) suggest that problem-finding is a necessary, but not sufficient condition for implementation. Engaging in problem-finding does not insure that a principal will make sound decisions but without using problem-finding he or she may not know which decisions need to be made. As Albert Einstein said, "The formulation of a problem is often more crucial than its solution" (Getzels, 1979, p. 5).

Economic Incentives

The successful implementation of technological innovations is not a function of the principal's ability to establish economic incentives for oneself and for one's staff to reward the extended time and effort necessary for implementation.

Providing economic incentives is not associated with technological implementation for two reasons. First, schools typically do not have the funds to provide such incentives. The most commonly cited obstacle to implementation was lack of funds to purchase hardware and software. Since money is frequently not available for capital outlay, it may not be available for incentives. School boards, then, appear to be content to use funds primarily for acquisition, not implementation. Until the community demands implementation, the board may not see fit to appropriate additional funds.

A second explanation is that teachers may not expect to receive economic incentives. Yearly raises are usually obtained through lengthy negotiation, and financial "rewards" are salary increases based on the teacher's length of service, amount of formal education, and his or her willingness to sponsor an activity such as student council, coach a sport, or take on a similar extra duty. Receiving a bonus for teaching a new skill during the school day is unthinkable to most educators. In fact, in many school districts teachers are not fully reimbursed for attending college classes or workshops in order to learn a new skill which they have been asked to teach. As noted in an earlier study (McGee, 1985) few teachers even mentioned financial incentives as a reason for implementation and when asked to indicate the one most important reason for implementing computers, only 0.3% responded "financial rewards." Motivation and commitment to implementation cannot be bought. The findings of the Rand study of innovations parallel the findings of this study as they reveal the futility of enticing commitment:

> Teachers typically elect to spend the time and energy necessary to carry out a new practice primarily out of professional concerns--because they believe these efforts will help them become better teachers. Extrinsic rewards such as pay for training cannot stimulate the commitment of teachers if they do not see it to be in their professional self-interest (Berman et al., 1978, p. 27).

Political Incentives

The successful implementation of technological innovations does not appear to be a function of the principal's ability to achieve recognition or "political" rewards from the school board, superintendent, or community for one's own and one's staff's efforts to implement the innovation.

Principals who provide political incentives have highly implemented computer curriculums though the causal effects of this variable diminishes when other variables are included in a regression analysis. Political incentives may include recognition from the principal, community and peers, more influence in the school, recognition in the local press, and increased professional status. These incentives may not seem particularly important to anyone not in education, but given the nature of the school they are important to teachers. Since financial incentives or rewards for implementing innovations are very limited, if they exist at all, recognition is an important symbol and is rare enough to be meaningful when given by a principal or parents. The data indicate, however, that providing more

incentives does not directly contribute to implementation except possibly in high SES schools.

Time and Attention

The successful implementation of technological innovations is not a function of the principal's ability to attend to and make daily decisions about matters of implementation throughout the duration of the implementation process.

Throughout the study, the only significant relationship between implementation and time and attention given to ongoing decision-making has been negative. This has been explained by the fact that principals are most involved when the program is in its early stages. Principals in schools with the lowest implementation scores were much more likely to have the highest level of ongoing decision-making scores while principals in schools with high implementation had an expected distribution of decision-making scores. Implementing an innovation requires time, attention, and active decision-making. Once a program is implemented, however, the principal's time and direct involvement decline. He or she is able to delegate decisions and need only spend an hour or two a week monitoring, evaluating, or managing the computer curriculum. Successful programs do not require a principal's daily, direct involvement.

Goal Setting

The successful implementation of technological innovations does not appear to be a function of the principal's ability to make the goals of implementation clear and operational to the teachers.

Principals who establish clear goals are likely to have schools with successful computer programs. One interpretation of this finding is that teachers respond to goals because they constantly create and use them to guide their daily instruction.

A second interpretation is that the success of the principal's goal-setting activity is due to his or her ability to identify and formalize the existing goals of the staff. Earlier, the author showed that goal congruence is associated with implementation (McGee, 1985). The relationship between goal-setting and successful implementation may be due not to the principal's ability to set organizational goals but to identify and adopt teachers' goals. As David Kolb points out: "Someone once said that the key to successful leadership is to find out which way people are going and then run out in front of them" (Kolb, 1983, p. 126). Although the data do not indicate whether the principal's goal-setting or goal-adopting leads to the establishment of clear and operational goals, it is the existence of these goals, not the means used to establish

them which is related to implementation. As with the provision of political incentives, the causal relationship is less important when other variables are included. Goal setting does contribute to implementation, but it is overshadowed by other actions of the principal and characteristics of the school and staff.

Principals' Computer Literacy

The successful implementation of technological innovations is not a function of the principal's ability to operate the technological innovation and acquire information regarding its implementation.

The final conclusion may not be true, however, for low SES schools. The principal's literacy level is moderately correlated with implementation for the low SES schools ($r = + 0.32$). The limited size of the subsamples prevent the author from determining causation through a regression analysis. Computer literate principals may help create strong computer curriculums, but the presence of a solid curriculum may enable the principal to become more literate. The author suspects that principals in low SES schools may have a direct impact on implementation. Recent research by Hallinger and Murphy (1985) supports this belief. They found that effective principals in low SES schools spent more time involved in direct and indirect leadership

activity while those in high SES schools were more involved in indirect activities.

Theoretical Implications

Although the major findings of this study may benefit the practicing principal, they also have important theoretical implications for the definition of instructional leadership. Most research and theory focuses on the leadership characteristics of principals in schools which have extraordinary student achievement. Instructional leadership, however, is often used without a precise definition (Hallinger and Murphy, 1985). In the absence of a precise definition, the literature promotes a "white knight" conception of an educational leader (Hallinger and Murphy, 1985). For example, in analyzing thirty-nine studies of effective principals in effective schools, Leithwood and Montgomery categorize principals as "effective" or "typical" (Leithwood and Montgomery, 1982). Effective principals place emphasis on student achievement of the basics and student well-being in the school; they have clear goals and objectives; they are actively concerned about teachers and instructional strategies they use. Typical principals are presented as managers who are concerned primarily with managing and maintaining a smooth

day-to-day operation. Although some moderate relationships exist between certain activities of effective principals and student achievement, none of the studies they review, however, determine whether effective principals make effective schools or whether effective schools make good principals.

The author's research indicates, however, that if successful implementation is used as a measure of effectiveness, the most effective principals are those who are typical by Leithwood and Montgomery's standards. They are not dynamic instructional leaders; rather, they are hard workers who spend long hours coordinating and facilitating a computer curriculum. Their most effective work may take place behind a desk or in August when school is not in session. These principals are the ones who spend time writing schedules and making contacts to get an inservice training program into the school; they take time to review software or talk to others who know where and how to obtain good software and helpful resources; they are busy trying to set up an atmosphere of acceptance for the new addition to the school.

Their management efforts are certainly more closely related to implementation than are the more dynamic areas of goal-setting, providing extensive moral support, and

becoming computer literate. To have a good program principals do not have to conduct training but provide it. They do not have to teach computer use to students but arrange conditions which enable it to happen. They do not have to be directly involved in the day-to-day decision-making about the computer curriculum, but delegate those decisions to competent resourceful individuals. They do not have to master new software, but know how to identify and acquire useful programs. A recent paper by Hallinger and Murphy shows that effective instructional leadership in high SES schools results from the principal's role as a coordinator. His or her indirect actions in promoting academic consistency, coordinating the curriculum, and "orchestrating" the educational program from the background are associated with exceptionally large academic gains in student achievement (Hallinger and Murphy, 1985).

The author's study suggests, as does Hallinger's and Murphy's, a new area of inquiry for the theory of instructional leadership. Effective instructional leadership may be the result of indirect coordinating activities frequently characterized as "management" duties. The development of a new theory of instructional leadership would have important policy implications for practicing administrators.

To summarize, this study shows that principals do influence the extent to which technology is used in their schools. Specifically, it indicates that particular decisions, management tasks, and procedures directly influence successful implementation. Microcomputers need not follow the patterns of past technology--falling into disuse a few years after their acquisition. A reading of the findings of this research will enable the principal to understand to what extent he or she can contribute to the implementation of a successful computer program. Sustained endorsement, moral support, and delegating decisions do not lead to implementation; active management and involvement do. Although the computer has the potential to make a tremendous impact on students and society, its potential cannot be fulfilled until it becomes part of the regular curriculum. By making key decisions regarding computer instruction and student use, and by actively managing implementation, the principal can further the implementation of microcomputers and create equitable, extensive access to this newest technological innovation.

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Table 1

Correlation Coefficients for Total Implementation Measure

Independent Variables	Correlation Coefficient
PF	.10
COORD	.48***
EC.INC	.12
POL.INC.	.40***
TIME/ATTN	-.19*
GOALS	.33***
P. LIT.	.22*

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 2

Correlation Coefficients for Total Implementation Measure by SES Subsamples

Independent Variables	Total Sample	SES Subsamples		
		low	average	high
PF	.10	.24	.09	-.13
COORD	.48***	.51*	.31**	.62**
EC.INC	.12	-.09	.03	.47
POL.INC.	.40***	.19	.22	.71***
TIME/ATTN	-.19*	.00	-.32**	-.02
GOALS	.33***	.21	.14	.55*
P. LIT.	.22*	.32	.08	.08

* $p < .05$ ** $p < .01$ *** $p < .001$

Figure 1. Stepwise regression equation for total implementation.

ITOTAL= .21* COORD + (- .36***) RATIO + (- .27**) SES
+ .22** SFTWR + (- .22**) ATT + .13 MEANS
+ (- .10) GOALS + (- .07) POL. INC + (- .01) P. LIT

* $p < .05$ ** $p < .01$ *** $p < .001$

Figure 2. R^2 values for dependent variables in stepwise model.

Dependent Variable		Independent Variables		Cumulative R^2 Value
ITOTAL	=	0.21	COORD	21.4
		- 0.36	RATIO	32.0
		- 0.27	SES	40.7
		+ 0.22	SFTWR	44.5
		- 0.22	ATT	48.2
		+ 0.13	MEANS	48.7
		- 0.10	GOALS	49.5
		- 0.07	POL.INC.	49.8
		- 0.01	P. LIT.	49.9